

THE FUTURE OF SPACE



In this Boeing photo, space shuttle Endeavor is rolled into the Vehicle Assembly Building for attachment to its flight hardware.

Everybody agrees that space launch is “broken,” in a term used widely today in policy circles within the Air Force and NASA. By broken, analysts mean launching payloads into space—whether it be a human or a satellite—cost too much, takes too long, and often fails spectacularly. The space shuttle fleet, a technologically advanced system when it was designed three decades ago, is today facing aging infrastructure, suppliers that have ceased to exist, and an increasing need for upgrades to keep its missions safe. Expendable rockets like the Titan IV often

require months of preparation on the launch pad before making their flights; most remain evolvants of the 1950s era ballistic missiles. What is needed, analysts say, is a fresh infusion of technology and some new wings for these old birds.

And that is exactly what is about to happen, as the future of space transportation is about to move from the debating field to the launching pad. Well, sort of.

Major changes and initiatives are underway that will shape the way the United States launches satellites and people into space in the years ahead. They

TRANSPORTATION

Is it Expendable? Reusable? Or the Shuttle? Why not all three?

BY FRANK SIETZEN, JR.

form the structure of three initiatives—space shuttle sustainment, a new family of cheaper expendable rockets, and a major effort at defining a fully reusable craft to follow the shuttle system.

THE FUTURE OF THE SPACE SHUTTLE

Today's space shuttle system—the orbiter, external fuel tank and pair of solid fuel booster rockets—was designed in the early 1970s, and built in the mid-1970s. The launching facilities at NASA's Kennedy Space Center in Florida were modified from those built in the early 1960s for the Apollo-Saturn launch vehicles. Most of these major modifications were completed by the early 1980s—some 20 years ago. Several of the main construction work ended earlier than that. Exposed to the harsh Florida coastal winds, salt air breezes, and rain, all matched by high levels of humidity and heat, the shuttle's launch base is constantly in need of renovations and maintenance. The workforce that sustains these operations is also aging. Estimates made in 2001 suggest that a majority of NASA employees are in middle age, and a large segment will be nearing retirement in the next decade. Hundreds of suppliers for small systems and equipment used on the shuttles and their facilities have either gone out of business entirely or been absorbed by rounds of mergers and acquisitions. Other firms have ceased manufacturing these parts, citing the dwindling level of profitability they entail. These pressures have forced NASA to pay top dollar to keep some of these ancient systems in supplies. In some cases, the agency and its contractors have earlier this year begun surfing Ebay looking for surplus parts for the shuttle fleet!

At issue is how best to maintain space shuttle operations, and how long until a successor reusable system emerges from the drawing boards. In the mid-1990s, NASA and the National Academy of Sciences initiated a review of what systems aboard the shuttle vehicles needed replacement by either more advanced technology, or new equipment that would lower the cost of shuttle flight while increasing safety. The result of this review was a detailed plan, set before Congress in 1999 to spend more than \$2 billion over the next decade in upgraded systems. In its original form, these upgrades would replace the orbiter's hydraulic steering system with an

all-electric design, new computer technology, less toxic thrusters, and other elements. The idea was to infuse new technology into the shuttles well before their retirement began, then envisioned to start in 2012 and end about 2014 when a new generation of shuttlecraft would be flying.

But NASA's budget has failed to grow over the past decade, while at the same time cost increases in the agency's flagship project, the International Space Station, have ballooned. Until the advent of the Bush administration in 2001, whenever cost increases in other programs have occurred, NASA has raided the budgets of other programs. More than \$600 million in shuttle spending has been deferred as a result, with upgrades affected. Some of the original upgrades reported to Congress were canceled, NASA saying that they had veered out of budget alignment or been rendered as not a priority in the new analysis. Most, however, had been deferred due to the cost pressures building in the human spaceflight program. Some of the more ambitious upgrades in the study phase, such as escape systems or new boosters, have been quietly shelved.

But the idea of retiring the shuttle beginning in 2012 has been itself the subject of a review, as the prospect of a second generation shuttle pushed further into the future by a combination of budget issues and technology. In the spring, new NASA administrator Sean O'Keefe ordered a review of the implications of continuing the use of the shuttles for not a decade more, but possibly to 2020—some 18 more years. And some in the space community have suggested that if the development of the new generation craft proves to be too challenging, that date could be extended even more, to 2025 or longer. O'Keefe's study is to assess what would be needed to maintain a reinvigorated shuttle fleet for nearly another quarter century: new systems, but also new upgraded pads, processing systems, and other related facilities. The pricetag won't be cheap—most likely in the billions. But if the new RLV takes longer than anyone expected, the issue will be how to continue to ferry astronauts and large payloads and equipment into space.

Is continued shuttle flight the best way to assure U.S. access to space until RLV II comes on line? Or would a combination of a small spaceplane, lifted

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into orbit by one of today's new generation of throw-away rockets be a better step?

That future of the shuttle review is to be completed by early next year. Then NASA, and the contractor community that maintains the fleet of shuttles, will face the decision of how best to keep U.S. astronauts flying.

THE SPACE LAUNCH INITIATIVE

Of course, to replace the shuttle would require development of something to replace it. Enter the NASA Space Launch Initiative. A five year, \$4.8 billion effort started in 2001, the SLI is intended to arrive at a series of both human-carrying reusable launchers as well as non-people carrying cargo craft by 2006. From more than 100 potential system designs, SLI has downselected to five space industry contractors and 15 potential launchers. In four years, the SLI effort is to recommend to NASA the form and capability of a fully reusable, commercially exploitable family of RLVs, all of whom are to be cheaper and more operable than the shuttle fleet.

So what's the problem with that?

Only many are convinced that SLI will need more than four years to come up with a shuttle replacement. Some are saying that in addition to viewgraphs, SLI should also include prototypes and test vehicles flying out some of the risk in building the new craft. For that there are no funds in the current budget.

And in addition, there is no funding "wedge" currently inserted in the NASA budget planning for 2007-2012 when the actual construction of the SLI-recommended craft would theoretically occur. The cost of the RLV could be in the \$16-\$20 billion range. In a flat budget environment, NASA would be hard pressed to build this shuttle replacement without a fresh—and major—infusion of cash.

Some members of Congress, like Florida Senator Bill Nelson (D) have suggested that the Pentagon should foot the bill for the technology development program for a new RLV. Recently, the Defense Department started their own SLI-like project aimed at researching military roles for a reusable launcher. Called the National Aerospace Initiative (NAI), this project is aimed at spending \$2.6 billion between now and 2008 on designs for something called a Space Maneuver Vehicle, an unpiloted reusable launcher and spacecraft combination. Unlike NASA's SLI, the NAI is to perform a space test flight of a prototype in 2008.

O'Keefe has suggested that SLI and NAI should work together and coordinate the reusable system that emerges from their studies. He has extended a "120 day One Team" joint NASA-USAF study that began to look last year at the common requirements the two agencies had for reusable launch vehicles. But no matter what designs finally emerge as the chosen form, funds will have to be found from either NASA, the USAF, or somewhere else to actually pay to build—and eventually operate—whatever type of reusable system that some day follows the shuttle fleet into space.

EVOLVED EXPENDABLE LAUNCH VEHICLE

For the expendable launcher field, the pathway to the future is not so clouded. By the time these words appear in your mailbox, a new generation of throwaway rocket will have taken to the skies above Cape Canaveral, Florida. If all goes well, nearly a decade of planning—and about \$3 billion in spending—will have yielded a new family of cargo rockets cheaper and more commercially competitive than any that have flown before. In 1992, the Defense Department, concerned that the cost of space launches of its military satellites was sufficiently high to consume greater and greater parts of the military space budgets, initiated yet another round of studies about U.S. space launch capabilities. This followed three previous launch studies of the late 1980s. The National Launch System, Advanced Launch System, and Spacelifter all looked at new generations of expendable space boosters, but all failed to obtain sufficient support in either the Pentagon or Congress to literally get off the drawing boards and into development.

The 1992 study, headed by Air Force General Thomas Moorman, resulted in a definitive series of recommendations when delivered to Air Force leadership in 1994. The key recommendation was development of a single family of rockets to replace the existing Atlas, Delta, and Titans. New boosters would be fully expendable, and would seek to have limited technology and development goals: reducing the cost of launch by 25 to 50 percent over the existing rocket fleet. These expendables—called Evolved Expendable Launch Vehicles—would begin flying in the early 21st Century, and initiate a gradual phase-out of the precursor boosters.

The pair of EELV families that emerged from the contract competition would be the Boeing Delta IV and the Lockheed Martin Atlas V. The Boeing rockets would feature the first new U.S.-made liquid rocket engine since the development of the shuttle. The Lockheed Atlas would import to the U.S. a variant of the Russian engine that powers that country's Energia and Zenit booster rockets. Together with state-of-the-art launching pads at Cape Canaveral and Vandenberg, the EELV era would deliver more commercially competitive launchers that would at last challenge the Ariane 5 for world commercial space launch leadership. The EELV program will support not only military and civil government space launches, but the rockets will be available for commercial contracts, lifting communication satellites and other satellite cargoes. While industry details are proprietary, both rocket families are believed to have slashed the cost of launching to record lows—making Atlas V and Delta IV tough new competitors.

That is, if they work.

First off the pad is the Atlas V inaugural launch, expected in early August, followed by the inaugural Delta IV, planned for late August.

Their flights will infuse new technological blood into the U.S. rocket industry. And if only SLI or NAI will do the same, U.S. access to space will improve as well, blazing a new trail for people and cargoes into the 21st Century skies. 